Invitation to Multimodal Medical Imaging

~ For Experimental and Clinical Research ~

Collaboration Center for Medical Innovation
Intellectual Property Management Division
Medical Photonics Research Center
Translational Research Center
Hamamatsu University School of Medicine has been focusing for over 20 years on basic experimental as well as clinical medicine using the leading-edge optical technologies (through exchanges with world-class companies). Currently, “Medical Photonics”, the state-of-the-art researches for basic and clinical medicine employing optical technologies, is one of the major characteristics of the university.

Our university has multimodal research equipment and environments for Medical Photonics. A large number of researchers and doctors are engaged in diagnostic study on a wide variety of clinical conditions using optical technologies, pharmacokinetic study, drug discovery, and development of medical devices using imaging technologies.

Meanwhile, Translational Research Center (“TR Center”) was established inside the University Hospital to allow Phase I clinical trial (first-in-human) in 2002. The Center serves as a bridge between animal study and human use, and has worked with pharmaceutical companies to actively conduct clinical trials.

Our university introduced animal MRI scanners, animal CT scanners, clinical PET-CT scanners, cyclotrons, and GMP-compliant hot labs from 2010 to 2011. At the same time, we also expanded the RI Experimental Animals Institute and established rental labs and the Collaboration Center for Medical Innovation. Now, we are set up to support research using imaging technologies that would serve as a bridge between experimental research and clinical trial (translational research).

Our university is a unique base for imaging technology research since it has equipment and facilities that allow study of small animals, primates, and humans in series, as well as researchers to carry out these studies. We hope that the equipment and facilities will be widely used in drug discovery using imaging technologies, diagnostic study on clinical conditions, and development of image processing technologies and also medical devices.

Features of imaging research at Hamamatsu University School of Medicine

1. Imaging modalities are gathered in one place
2. Clinicians and researchers work together in research projects
3. Study can be conducted in series from experimental to clinical levels
4. Active engagement in research and development of medical devices

Outline of Hamamatsu University School of Medicine

<table>
<thead>
<tr>
<th>Department</th>
<th>Faculty of Medicine, Faculty of Nursing, and University Hospital</th>
</tr>
</thead>
<tbody>
<tr>
<td>President</td>
<td>Satoshi Nakamura, MD, PhD.</td>
</tr>
<tr>
<td>Number of students</td>
<td>1,077 (971 undergraduates)</td>
</tr>
<tr>
<td>Number of academic staff</td>
<td>1,174 (124 researchers)</td>
</tr>
<tr>
<td>University Budget</td>
<td>42,168,608,680 yen (FY2010 closing figure)</td>
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</tbody>
</table>

Imaging Facilities

**All imaging facilities are inside a university campus**

**Collaboration Center for Medical Innovation**

The Collaboration Center for Medical Innovation was established in April, 2011 as a one-window for industry-academic collaboration and medical-engineering collaboration. The Center includes the PET-CT building and the cyclotron building. Imaging devices in the university used with small animals and humans (MRI scanners for research, CT scanners, and animal PET scanners) are managed by this Center.

**Medical Photonics Research Center**

In April, 2011, the former Photon Medical Research Center and the former Molecular Imaging Frontier center were integrated into the Medical Photonics Research Center. A wide variety of medical research is conducted using optoelectronics and electromagnetic waves with humans and model animals. At this Center, advanced research is now being conducted including: life phenomenon study through industry-academic collaboration and exploratory clinical trial to apply results of animal study to clinical trial are conducted.

**Experimental Animals Institute**

The Experimental Animals Institute was established in 1979 to conduct animal study as experimental medical research. The facility not only provides specialized knowledge to researchers but also contributes to education through lectures on laboratory animal science and graduation thesis research. At the same time, the facility contributes to developing the field of laboratory animal science by breeding mutant mice as human disease-model animals by a uniquely developed method and providing them to researchers. One of the recent focuses now is breeding of common marmosets, and the facility is promoting the use of them as the animal model. At the facility, mice, rats, and animals in between are used in research.

**Translational Research Center (TR Center)**

The Translational Research Center was established in March, 2002 as a facility specialized in clinical research in the University Hospital. At this Center, clinical trial (Phases I and II) is conducted through industry-academic collaboration and exploratory clinical trial to apply results of animal study to clinical trial are conducted.

**Locations of Imaging Facilities and University Hospital**

The PET-CT building is adjacent to the Radiology Department of the University Hospital and is connected with it via a hallway. The TR Center that uses clinical PET-CT scanners for clinical trials is located in front of the PET-CT building. Also, the cyclotron building for cell and animal research is adjacent to the Medical Photonics Research Center.
For experimental study and non-clinical study

**PET/SPECT/CT system** at cyclotron building

**GE, "FX System"**
- PET, SPECT, and CT scanners are installed on one system. It can produce images in various modalities without having to move a subject animal. It can also fuse images of different modalities.
  - Field of view: approximately 30 cm of diameter, and approximately 30 cm of length
  - Spatial resolution: 1.0 mm for PET, 3.0 mm for SPECT, and 5.0 mm for CT

**16 channel X-ray CT scanner** at experimental animals institute

**GE, "BrightSpeed Elite SD" clinical machine**
- It is a multi-detector row CT (MDCT) scanner with 16 detector rows that realizes high image quality through sub-high pitch helical rotation of 50 cm in approximately 10 cm and by use of the Clear View Image Reconstruction (CViR) technology. With a sophisticated workstation and 3D application, it can create 3D images and conduct a wide variety of analysis.
  - Speed: 0.8 sec/row and 4 sec/patient
  - Output: up to 350 mA (120 kV)
  - Speed: as fast as 0.8 seconds per rotation

**3T MRI system** at experimental animals institute

**GE, "Discovery MR750"**
- Magnetic field strength of 3T allows acquisition of high quality images. It has coils exclusively developed for small animals (rats and mice); therefore, it can create images of various sizes of animals from small animals to primates.
  - Static magnetic field homogeneity: 0.25 ppm (40 cm DSV)
  - Maximum gradient magnetic field strength: 50 mT/m, and slew rate (SR) of 150 mT/m per second
  - Field of view: approximately 10 cm of diameter, and approximately 10 cm of depth

**PET/CT system** at PET/CT building

**SIEMENS, "TruePoint Biograph 16"**
- This system is an integration of the 16-slice CT scanner "SOMATOM Emotion 16" and advanced PET function. It is designed to provide a higher spatial and temporal resolution in PET imaging, and to facilitate higher sensitivity in PET imaging. It is also designed to achieve lower noise in PET imaging. It is a high-quality PET/CT system.
  - Field of view: approximately 10 cm of diameter, and approximately 10 cm of length
  - Spatial resolution: 3.0 mm for PET, 3.0 mm for SPECT, and 5.0 mm for CT

**3T MRI system** at university hospital

**GE, "Discovery MR750"**
- It is the highest-end model of the GE 3T MRI. It provides maximum reduction of image unevenness attributed to a magnetic field and can carry out high-speed and high-definition imaging of not only the head but also the entire body. It also allows vascular pathology assessment through 3D blood flow analysis, higher brain function analysis through brain function imaging, and metabolism analysis through MR spectroscopy.
  - Static magnetic field homogeneity: 0.25 ppm (40 cm DSV)
  - Maximum gradient magnetic field strength: 50 mT/m, and slew rate of 200 mT/m per second

**PET/CT system** at PET/CT building

**SIEMENS, "TruePoint Biograph 16"**
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  - Spatial resolution: 3.0 mm for PET, 3.0 mm for SPECT, and 5.0 mm for CT

**Luminescence and fluorescence imaging systems** at RI management section of the cyclotron building

**Caliper, "IVIS 200" (left)**
- It is a high-performance in-vivo luminescence imaging system. It can carry out ultrasensitive luminescence imaging and 3D imaging of very small animals from small animals to primates.
  - Spatial resolution: 1.6 mm for PET, 0.5 mm for SPECT, and 50 mm for CT
  - Field of view: approximately 10 cm of diameter, and approximately 10 cm of depth

**Caliper, "IVIS 200" (right)**
- It is a high-performance in-vivo luminescence imaging system. It can carry out ultrasensitive luminescence imaging and 3D imaging of very small animals from small animals to primates.
  - Spatial resolution: 1.6 mm for PET, 0.5 mm for SPECT, and 50 mm for CT
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**3T MRI system** at university hospital

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  - Spatial resolution: 3.0 mm for PET, 3.0 mm for SPECT, and 5.0 mm for CT

**GMP-compliant hot lab** at cyclotron building

**Sumitomo Heavy Industries, "HOT CELL"**
- Universal Giken, "4-Consecutive Hot Cell" is a hot lab for automatic drug synthesis that has met the good manufacturing practice (GMP) standard for experimental drugs with regard to manufacturing equipment and quality control of pharmaceuticals. At the university, this system can be used in clinical trials and synthesis of drugs to be used in microprobe approach.

**Animal preparation / feeding rooms** at cyclotron building / experimental animals institute

**There is a small preparation room for feeding experimental animals in the management section of the cyclotron building. Time changes in individual animals can be observed in this building.**

**Equipment available for external use**

If PET/CT equipment is not available, the PET/CT scanner is available for use by external parties without requiring them to enter into a joint study or contracted study agreement. Please refer to the attached document for usage fees. We are able to give you advice on device selection and equipment for those who are carrying out in-vivo imaging for the cyclotron.
From Experimental Study to Clinical Trial

Hamamatsu University School of Medicine has imaging modalities that can handle all levels of studies from Experimental to clinical trials, lecture and research centers for experimental studies, the University Hospital for clinical trials, the Clinical Trial Center for clinical trials, and TR Center. Therefore, complete research and development of pharmaceuticals and medical devices can be carried out at our university.

Hamamatsu University School of Medicine has been designated as a specialist training institute in the Japan Advanced Molecular Imaging Program (J-AMP) implemented by the Ministry of Education, Culture, Sports, Science and Technology. Our university is now promoting training of PET researchers who use small animals, primates, and other sizes of animals in between to develop imaging probes and design imaging technology applications.

Our university works together with local companies and medical institutions to train the next-generation PET researchers. More specifically, we train doctors and researchers who can use imaging technologies to contribute to medical practice and translational research.

**Features of clinical trials at Hamamatsu University School of Medicine**

- Has rich achievements and experience in clinical trials
- Can conduct experimental studies and clinical trials (from Phase I to IV) in sequence
- Can conduct early exploratory clinical studies and clinical trials (Phase I) on contract
- Can conduct investigator-initiated trials
- Has GMP-compliant hot labs
- Can give advice on design and development of imaging probes
- Has access to a local clinical trial network

**Research Centers**

- Center for Clinical Research
- Translational Research Center (TR Center)
- University Hospital

**Faculty of Medicine (basic and clinical lecturers)**

- Medical Photonics Research Center
- Research Center for Child Mental Development
- Collaboration Center for Medical Innovation
- University Hospital

**Number of joint and contracted studies (FY2011)**

<table>
<thead>
<tr>
<th>Category</th>
<th>Number</th>
</tr>
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<tbody>
<tr>
<td>Joint studies</td>
<td>46</td>
</tr>
<tr>
<td>Contracted studies</td>
<td>5,067</td>
</tr>
<tr>
<td>General</td>
<td>54</td>
</tr>
<tr>
<td>Clinical trials</td>
<td>253</td>
</tr>
<tr>
<td>Pathological examination</td>
<td>4,760</td>
</tr>
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**Totoumi Clinical Trial Network**

This network was created to support clinical trials of new drugs. The members of the network are Hamamatsu University School of Medicine, Saisei Hamamatsu General Hospital, Saisei Mikatahara General Hospital, Hamamatsu Medical Center, Iwata City Hospital, Enshu Hospital, and the Hamamatsu Medical Association. The member hospitals are all located in the western part of Shizuoka prefecture.

**Features of the network**

- Has rich achievements and experience in clinical trials
- Can conduct experimental studies and clinical trials (from Phase I to IV) in sequence
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- Can conduct investigator-initiated trials
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### Development of Medial Devices through Medical-Engineering Collaboration

**Point 3**  
Active engagement in research and development of medical devices through medical-engineering collaboration

One of the characteristics of Hamamatsu University School of Medicine is active and frequent engagement in development of medical devices through collaboration with companies. In 2009, the research projects "the practical development of medical photonics-based products" in Hamamatsu University School of Medicine was selected as Privileged Area for Medical Research and Development by the Japanese Cabinet Office.

Hamamatsu University School of Medicine is now engaged in joint research and development with companies with the goal of commercialization of new medical devices with imaging technologies.

[Projects of the Privileged Area for Medical Research and Development]

#### Development of a surgical navigator, a stereo endoscope, and an ultrasound probe to assist an minimally invasive endoscopic surgery

**Researchers**
- Seiji Yamanouchi (Professor, Medical Photonics Research Center)
- Hironobu Hoshino (Vice-Director and associate professor of the Department of Orthopedics, University Hospital)
- Naoki Unno (Director and associate professor of the Department of Vascular Surgery, University Hospital)
- Kazuo Umemura (Professor of pharmacology, Department of Medicine)
- Kyusuke Uranishi (Professor of medicine, Department of Medicine)
- Hiroyuki Ogura (Vice-Director and assistant professor of the Department of Breast Surgery, University Hospital)
- Norihiko Shiiya (Director and professor of the Department of Breast Surgery, University Hospital)
- Naoshi Koizumi (Assistant professor of the Department of Orthopedics, University Hospital)
- Hironobu Hoshino (Vice-Director and associate professor of the Department of Orthopedics, University Hospital)

**Cooperating companies**
- Hamamatsu Photonics (HAMAMATSU)
- Honda Electronics
- Hamamatsu Medical Instruments
- Amelio, Pulstec Industrial
- Hamamatsu University School of Medicine

#### Development of a next-generation PET diagnosis system for contributing to treatment of mental illnesses

**Researchers**
- Yasuo Duchi (Professor, Medical Photonics Research Center)
- Yasuhiro Magata (Professor, Medical Photonics Research Center)

**Cooperating company**
- Hamamatsu Photonics (HAMAMATSU)

#### Development and clinical assessment of an optical mammography system for breast cancer diagnosis

**Researchers**
- Harumi Sakahara (Director and professor of the Department of Radiology, University Hospital)
- Hiroyuki Mineta (Director and professor of the Department of Otorhinolaryngology, University Hospital)
- Teiji Nakayama (Director of the Emergency Care Center, Hamamatsu Medical Center)
- Seiji Yamamoto (Professor, Medical Photonics Research Center)
- Hironobu Hoshino (Vice-Director and associate professor of the Department of Orthopedics, University Hospital)
- Hironobu Hoshino (Vice-Director and associate professor of the Department of Orthopedics, University Hospital)
- Naoki Unno (Director and associate professor of the Department of Vascular Surgery, University Hospital)

**Cooperating companies**
- Hamamatsu Photonics (HAMAMATSU)
- Kamei Medical Systems (KAMIEI)
- Pulstec Industrial

#### Development of a laser thrombolysis treatment system

**Researchers**
- Kenji Uemura (Professor of pharmacology, Department of Medicine)
- Taj Nakayama (Director of the Emergency Care Center, Hamamatsu Medical Center)
- Seiji Yamamoto (Professor, Medical Photonics Research Center)
- Hironobu Hoshino (Vice-Director and associate professor of the Department of Orthopedics, University Hospital)
- Naoki Unno (Director and associate professor of the Department of Vascular Surgery, University Hospital)
- Kazuo Umemura (Professor of pharmacology, Department of Medicine)

**Cooperating companies**
- Hamamatsu Photonics (HAMAMATSU)
- Kamijima Denkosha
- Nagashima Medical Instruments
- Amelio, Pulstec Industrial

#### Development of a 3D X-ray assessment system for use in outpatient care

**Researchers**
- Harumi Sakahara (Director and professor of the Department of Radiology, University Hospital)
- Hiroyuki Mineta (Director and professor of the Department of Otorhinolaryngology, University Hospital)
- Teiji Nakayama (Director of the Emergency Care Center, Hamamatsu Medical Center)
- Seiji Yamamoto (Professor, Medical Photonics Research Center)
- Hironobu Hoshino (Vice-Director and associate professor of the Department of Orthopedics, University Hospital)
- Naoki Unno (Director and associate professor of the Department of Vascular Surgery, University Hospital)
- Kazuo Umemura (Professor of pharmacology, Department of Medicine)

**Cooperating companies**
- Hamamatsu Photonics (HAMAMATSU)
- Zodiac

#### For promoting and supporting industry-academic collaboration

**Hamamatsu Medical and Engineering Technology Innovation Core**

The Hamamatsu and Higashi Mikawa regions are strong in the field of optical and electronic engineering, which can provide basic technologies for almost any kind of industry. In a regional innovation strategy support program called “Hamamatsu and Higashi Mikawa Life Photonics Innovation” that focus on the field of optical and electronic engineering, these two regions are the bases for promotion of the health and healthcare industry which is one of the four industries that are becoming essential as new leading industries. The base offers opportunities for doctors and local companies to exchange information and for local companies to see the site of medical practice as a framework for creating a chain of continuous innovations by integrating high-level engineering and development skills accumulated in Hamamatsu area, whose strength is production and manufacturing, and needs in the fields of medical practice and medicine.

Hamamatsu and Higashi Mikawa regions are strong in the field of medical technology innovation, which is the core of medical practice and medicine in the local area. The Hamamatsu and Higashi Mikawa Life Photonics Innovation (HAMLPI) is a regional innovation strategy support program that focuses on medical technology innovation. The base offers opportunities for local companies to provide engineering and development skills to local medical practices and for local medical practices to exchange information with local companies. The base also provides opportunities for local companies to provide engineering and development skills to local medical practices and for local medical practices to exchange information with local companies.

For promoting and supporting industry-academic collaboration

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Collaboration Center Committee (monthly meeting)

The Collaboration Center Committee consists of members engaged in operations related to industry-academia-government collaboration (president of the university / director of the IPMD, director of the Collaboration Center, director of the TR Center, et al.). This committee provides opportunities to all the members to check internal / external trends in industry-academia-government collaboration, check other members’ operational progress, and discuss future actions for the university.

The Collaboration Center works together with the IPMD and serves as a one-window for implementation of industry-academia collaboration and medical-engineering collaboration inside and outside the university. The Center provides support for development and commercialization of medical devices, answers questions about pharmaceutical regulations, collects needs for Clinical practice, and suggests partners in medical-engineering collaboration.
Images in the cover page (in sequence from the left)

- Mouse: Tumor imaging / SPECT-CT
- Rat: Cardiac muscle imaging / PET-CT (18F-FDG)
- Rabbit: Analysis of the hemodynamic status of the heart / MRI
- Marmoset: Local FDG analysis of the brain / PET-CT (18F-FDG)
- Cynomolgus monkey: Brain blood vessel MRA (MRA 2 slab)
- Human: Serotonin receptor / PET-MRI (11C-DASB)

Access and Location

[By bus]
Get on a bus from bus stop #13 at the bus loop outside the Hamamatsu station north exit, and get off at "Ika Daigaku Mae."
The bus number is 50 (for City Hall, Yamanote, and Iida) and it takes approximately 40 minutes.

[By Shinkansen]
*Only a few Hikari trains stop at Hamamatsu station.*
From Tokyo to Hamamatsu: approximately 90 minutes by HIKARI, and approximately 120 minutes by KODAMA
From Shin-Osaka to Hamamatsu: approximately 90 minutes by HIKARI, and approximately 120 minutes by KODAMA

[By car]
From Tomei Expressway Tokyo interchange to Hamamatsu interchange: approximately 120 minutes
From Tomei Expressway Nagoya interchange to Hamamatsu-Nishi interchange: approximately 45 minutes